

Serial No.: 09/544,344

PATENT APPLICATION  
Docket No.: NC 84,337

## REMARKS

Claims 1, 2, 4-9, 21, 22, 25-38, and 40-55 are pending in the application. Claims 52-55 have been added by this amendment. Claims 1, 2, 4-9, 21, 22, 25-38, and 40-51 have been rejected. Claims 28, 35, 36, and 42 have been held to recite patentable subject matter.

Claims 1, 21, 25, 27, 33, and 34 have been amended to recite that the ligand shell molecules are not coupling agents. Support for this amendment is found in Fig. 1 and at page 18, lines 4-16.

Claims 1 and 25 been amended to recite that the tail functional group can be an araliphatic group. Support for this amendment is found in claim 41.

Claims 2 and 22 are clarified by changing "such metals" to "thereof."

Claim 5 has been clarified by the addition of the word "further."

Claims 37 and 50 are amended to cancel NH<sub>2</sub>.

New claims 52 and 53 recite the absence and presence of coupling agents in the ligand shell. Support is found in Fig. 1 and at page 18, lines 4-16

No new matter has been added.

## Interview Summary

The Examiner and Applicants' representative conducted an in person interview on 01/10/2005. The composition of the ligand shell was discussed. It was agreed that a claim that excluded coupling agents would probably be allowable over the art applied.

## Claim Objections

Claims 5 and 46 have been objected to as being of improper dependent form for failing to further limit the subject matter of a previous claim. Claim 5 (claim 46 dependent thereon) recites "a primary aliphatic hydrocarbon moiety in the tail portion of its structure." This group was not included in the Markush group of claim 1, upon which claim 5 depends. However, the Markush group in claim 1 only limits the tail functional group, not the entire tail. Claim 5 has been clarified to recite that the ligand shell molecule further comprises a primary aliphatic hydrocarbon moiety in the tail.

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## Claim Rejections – 35 U.S.C. § 112

Claims 1, 2, 4-9, 21, 22, 25-38, and 40-51 have been rejected under 35 U.S.C. § 112, second paragraph as being allegedly indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

The Examiner questioned whether the language “the tail having a structure and composition designed to provide additional stabilization of metal clusters against irreversible agglomeration” in the independent claims prevents a bifunctional molecule from being in the ligand shell. An example of a bifunctional molecule, or coupling agent, is an  $\alpha,\omega$ -dithiol. The present amendment adds the language “that are not coupling agents” in describing the ligand shell molecules, as coupling agents would cause irreversible agglomeration. This clarifies that the ligand shell must contain at least some molecules that do not couple to other particles.

Coupling agents for metals that may be present in the cores are known to those of ordinary skill in the art. Fig. 1 schematically illustrates the recited assembly of claim 1, where the ligand shell contains only molecules that are not coupling agents. However, the ligand shell may further comprise coupling agents in addition to the molecules that are not coupling agents. Particles that are specifically free of coupling agents are recited in claim 52, and particles that specifically contain coupling agents are recited in claim 53.

As to claims 37 and 50, the Examiner stated that the recited  $\text{NH}_2$  group could bond to another particle. The amine group has been canceled from the claims.

As to claims 2 and 22, the Markush group ended with “an alloy of two or more such metals.” This has been amended to “an alloy of two or more thereof.”

As to claims 41 and 47, these claims recited araliphatic. The Examiner stated it was not clear whether this term found antecedent basis in claim 1. By this amendment, the term is added to claim 1.

As to claims 47 and 48, the Examiner stated that the claims recited both a genus and species falling within the genus. The Examiner cited to MPEP 2173.05(c). In all the examples in this section, the claim is objectionable because of the use of “such as,” “for example,” or other indefinite language. No such language appears in the present claims. Further, MPEP 2173.05(o) states that there is no *per se* rule against double inclusion in a claim.

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Claims 1, 2, 4-9, 21, 22, 25-38, and 40-51 have been rejected under 35 U.S.C. § 112, first paragraph as allegedly failing to comply with the enablement requirement. The Examiner stated that, according to the specification, the solution casting and slow evaporation method does not produce an acceptable film, but that the spraying method of claim 28 does. (Applicants assume that the rejection does not actually apply to claim 28.) The Examiner also stated that the layer-by-layer method was excluded from the scope of the claims.

Firstly, the layer-by-layer method and product made thereby are not excluded from the scope of the independent claims. As explained above, the claims cover particles both with and without coupling agents.

As to claims 1, 2, 4-9, 21, 22, 25, 26, 33-38, and 40-51, these are product claims. It appears that the Examiner would withdraw the rejection if these claims were limited to the spraying process. This would make them product-by-process claims. However, a product-by-process claim is not limited to products made by the recited process. Reciting the spraying process in these claims would not actually change the scope of the claim.

“As long as the specification discloses at least one method for making and using the claimed invention that bears a reasonable correlation to the entire scope of the claim, the enablement requirement of 35 U.S.C.112 is satisfied.” MPEP 2164.01(b). Here, the specification discloses at least two processes. The spraying process is suitable for couple agent-free particles. The layer-by-layer method is suitable when a coupling agent is used. The fact that other methods exist that either fail to make the claimed product or that make the claimed product less than optimally does not bear on whether the specification teaches at least one method that does produce the claimed product. (“Failure to disclose other methods ... does not render a claim invalid.” MPEP 2164.01(b)) The fact that other methods may be disclosed does not change the enablement analysis of product claims.

As to claims 27-32, these are method claims. As stated above, the independent claim covers particles both with and without coupling agents. The specification discloses the spraying method and the layer-by-layer method as possible methods of “depositing on a substrate ... a thin film of a multiplicity of particles in a three-dimensional close-packed orientation,” as recited in claim 27. The specification also discloses a solution casting method. Page 17, lines 9-11. The Examiner stated that this part of the specification teaches that this method does not produce an acceptable film. However, the specification actually says that the method “does not produce a

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thin film with reproducibility and acceptable uniformity." It does however, produce a film that is within the scope of "a thin film of a multiplicity of particles in a three-dimensional close-packed orientation," as recited in the claim. Even if such a film were unacceptable, "the presence of inoperative embodiments within the scope of a claim does not necessarily render a claim nonenabled." MPEP 2164.08(b).

#### Claim Rejections – 35 U.S.C. § 103

Claims 1, 2, 4, 5, 7, 9, 21, 22, 25-27, 33, 34, 37, 38, 40, 41, 46, 47, and 49-51 have been rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Bethell (*J. Electroanal. Chem.*) in view of Nakanishi (*Chem. Phys. Lett.*) or Hostetler (*J. Am. Chem. Soc.*).

The publication date of Nakanishi is 10/31/1997. The priority date of the present application is 11/25/1997. The reference is available as prior art only under 35 U.S.C. § 102(a) and may be disqualified as a reference by a declaration under 37 C.F.R. § 1.131. The attached declarations from the inventors show that the invention was reduced to practice no later than 05/15/1997, which is before the date of the reference. (See page 9, which discloses an embodiment of a gold core with a thiooctane shell, and Fig. 1.) The Nakanishi reference is disqualified as prior art.

Bethell discloses a colloidal solution of nonanethiol-derivatized gold nanoparticles (page 138, left column, 2<sup>nd</sup> full paragraph). Bethel also discloses a structure made layer-by-layer from a substrate, gold nanoparticles, and a dithiol (page 139, 1<sup>st</sup> full paragraph and Fig. 3).

Hostetler discloses  $\omega$ -functionalized alkanethiolate-Au clusters affixed to a Au surface using dithiol linkers.

The references do not disclose the combination of limitations in claim 1 that the particles are in three-dimensional close-packed orientation on a substrate, and that the tail has a structure and composition designed to provide additional stabilization of metal clusters against irreversible agglomeration.

Bethell's three-dimensional structure contains a dithiol coupler, but not a ligand shell molecule as recited in claim 1. The ligand shell molecule is significant in that it allows for the ligand shell to be capable of interacting with a chemical species in a target environment such that an electrical property of the particles is altered, as recited in claim 1. The three-dimensional structure of Bethell does not have this property.

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Hostetler discloses making only a 0.14 monolayer coverage of the clusters (p. 4213, last paragraph). Although the possibility of a three-dimensional architecture is mentioned in the last sentence of the article, a method of making this is not disclosed. Since only a 0.14 monolayer of clusters was achieved on a substrate, the bound clusters are too far apart to form a three dimensional structure by the layer-by-layer method. Not enough clusters can be attached to form a three-dimensional close-packed orientation of the particles

Claims 21 and 25 are each directed to an assembly and claims 33 and 34 are each directed to a system, each claim reciting three-dimensional close-packed particles on a substrate as recited in claim 1 and are asserted to distinguish from the reference in the same manner as claim 1. Claim 27 is directed to a method of fabricating an assembly also comprising three-dimensional close-packed particles on a substrate as recited in claim 1 and is asserted to distinguish from the reference in the same manner as claim 1. Claims 2, 4, 5, 7, 9, 22, 26, 37, 38, 40, 41, 46, 47, and 49-51 depend from and contain all the limitations of one of the above independent claims and are asserted to distinguish from the reference in the same manner as claim 1.

Claims 2, 4, 6, and 22 have been rejected under 35 U.S.C § 103(a) as allegedly unpatentable over Bethell in view of Nakanishi or Hostetler and in further view of Natan (US 5,609,907).

As in Bethell and Hostetler, Natan does not disclose three-dimensional close-packed particles on a substrate having a ligand shell as recited in claims 1 (claims 2, 4, and 6 dependent thereon) and 21 (claim 22 dependent thereon).

Claims 27, 29-32, and 43-45 have been rejected under 35 U.S.C § 103(a) as allegedly unpatentable over Bethell in view of Nakanishi or Hostetler and in further view of Terrill (*J. Am. Chem. Soc.*) and Andres (*Science*).

Terrill discloses films of gold clusters stabilized by alkanethiolates (abstract).

Andres discloses monolayers of gold clusters encapsulated by alkyl thiols and, optionally, interconnected by dithiols (Abstract)

As in Bethell and Hostetler, neither Terrill nor Andres discloses three-dimensional close-packed particles on a substrate having a ligand shell as recited in claim 27. Claim 27 recites that

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the tail functional group is a heterofunctional group, an aromatic group, a secondary aliphatic group, or a tertiary aliphatic group. None of these groups are disclosed in the three dimensional structure of Terrill. Andres does not disclose a three dimensional structure.

Claims 29-32 and 43-45 depend from and contain all the limitation of claim 27 and are asserted to distinguish from the reference in the same manner as claim 27.

In view of the foregoing, it is submitted that the application is now in condition for allowance.

In the event that a fee is required, please charge the fee to Deposit Account No. 50-0281, and in the event that there is a credit due, please credit Deposit Account No. 50-0281.

Respectfully submitted,



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